

REMARKS

The amendments in the Specification have been made to eliminate typographical and transcription errors. No new matter is being added.

Claims 1 – 8, 10 – 37, and 69 – 86 are currently pending in this application.

Claim 1 has been amended to include the limitation of "an amorphous" hydrogen barrier layer material. Support for the limitation is found in the specification at, among other places: page 5, lines 1 and 6; page 6, lines 7 and 18; page 17, line 27; and page 28, lines 23 and 24. Dependent claims 17, 18, 23, 24, and 27 were amended to improve the clarity of the language or to correct spelling. No new matter was added.

Independent claim 28 was amended to add titanium oxide, zirconium oxide, and aluminum oxide to the group of amorphous hydrogen barrier layer materials, and to add the limitation that at least a portion of the amorphous hydrogen barrier layer material directly contacts the thin film of metal oxide material. Support for the new compounds is found in the specification at page 28, lines 19 and 20. Support for the limitation that the amorphous hydrogen barrier layer material directly contacts the thin film of metal oxide is found in the specification at, among other places: page 17, lines 12 – 20, with reference to FIG. 4; page 19, lines 13 – 15; page 20, lines 19 – 26, with reference to FIG. 7; and page 21, lines 4 and 5. Independent claims 35 and 37 were amended to improve the clarity of the language. No new matter was added.

New, independent claim 69 was added to claim an integrated circuit having the limitation that there is no silicon-containing material located between the amorphous hydrogen barrier layer and the thin film of metal oxide. Support for claim 69 is found in the specification at: page 4, lines 22 – 26; FIG. 1, depicting hydrogen barrier layer 36 and metal oxide layer 30 with no silicon-containing material between them; FIG. 2, showing hydrogen barrier layer 88 and metal oxide thin film 70 with no silicon-containing material between them; FIG. 3, showing hydrogen barrier layer 160 and metal oxide thin film 110 with no silicon-containing material between them; FIG. 4, discussed at page 16, line 28, showing amorphous hydrogen barrier layer 230 and metal oxide thin film 216 with no silicon-containing compound between them; FIG. 5, showing hydrogen barrier layer 288

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and metal oxide thin film 302 with no silicon-containing material between them; FIG. 6, showing hydrogen barrier layer 362 and metal oxide thin film 356 with no silicon-containing material between them; and FIG. 7, showing amorphous hydrogen barrier layers 395, 406 and metal oxide thin film 396 with no silicon-containing compound between them. New dependent claims 70 – 84 contain limitations similar to those in the originally filed claims.

New independent claim 85 claims an integrated circuit having a hydrogen barrier layer comprising strontium tantalite formed from a liquid metal organic precursor in a process using MOCVD conducted at a temperature in a range of from 300°C to 650°C. Support for claims 85 and 86 is found in the specification at: page 5, lines 1 – 7; page 8, lines 19 – 21; page 13, lines 28 – 31; page 16, lines 23 – 27; and page 25, lines 25 – 28.

Claim Rejections – 35 USC §102

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). See MPEP §2131.

Claims 38 – 44 and 46 were rejected under 35 USC 102(a) as being anticipated by Amanuma, U.S. Patent No. 6,188,098 B1, issued February 13, 2001 (hereinafter "Amanuma").

Claim 38 and dependent claims 39 – 46 have been canceled.

Rejections Under 35 USC §103

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all of the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art,

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and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed.Cir. 1991). MPEP 2142 and MPEP 2143 – 2143.03.

Also, if a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. MPEP 2143.01, citing *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

Furthermore, if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. MPEP 2143.01, citing *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1951).

Claims 1 – 4, 10 – 12, 20 – 22, 28 – 30, and 36 were rejected under 35 USC 103(a) as being unpatentable over Kanaya, U.S. Patent Application Publication No. U.S. 2002/0038402 A1, published March 28, 2002 (hereinafter "Kanaya") in view of Shimada et al., U.S. Patent No. 6,351,004 B1, issued February 26, 2002 (hereinafter "Shimada").

In view of the new limitation of an "amorphous" hydrogen barrier layer material in amended claim 1, it is believed that currently amended independent claim 1 and dependent claims 2 – 8, 10 – 18, and 20 – 27 are nonobvious and patentable over the proposed combination of Kanaya and Shimada.

Currently amended claim 1 includes a limitation that the hydrogen barrier layer comprises "an amorphous hydrogen barrier layer material selected from the group consisting of strontium tantalate, bismuth tantalate, and tantalum oxide."

In the Final Office Action dated June 16, 2003, the Examiner wrote that Kanaya discloses a thin film of metal oxide material 304, and a hydrogen barrier layer 402 selected from the group comprising titanium oxide, zirconium oxide, and aluminum oxide. Significantly, the Examiner noted that Kanaya does not teach a hydrogen barrier layer comprising strontium tantalate, bismuth tantalite, or tantalum oxide.

In the Final Office Action dated June 16, 2003, the Examiner further wrote that Shimada discloses "a hydrogen barrier film that comprises one of silicon oxide, strontium tantalate or strontium titanate, wherein one of these materials is used for the disclosed

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intended purpose of preventing the oxidation of the conductive layers surrounding the metal oxide material."

The Examiner's interpretation of the Shimada reference is incorrect. The Examiner did not specify the parts in Shimada to which reference was made; however, Applicants assume that the relevant section of the Shimada reference includes the discussion of FIG. 5 beginning at column 4, line 40. Shimada discloses a second insulating layer 8, such as SiO_2 , SrTa_2O_6 , SeO_2 , or SrTiO_3 , and a floating electrode 9 interposed between source 3, insulator 5, and drain 4 on one side, and ferroelectric layer 6 on the other side. See Shimada, column 4, lines 44 – 62. Shimada teaches that floating electrode 9 is provided to keep the ferroelectric layer 6 from direct contact with source 3 and drain 4. See Shimada, column 4, lines 49 – 51. Floating electrode 9 prevents oxidation in source 3 and drain 4 by preventing contact of oxide ferroelectric layer 6 with source 3 and drain 4. See Shimada, column 4, lines 51 – 54. Floating electrode 9 also helps stabilize growth of ferroelectric crystalline material. See Shimada, column 4, lines 54 – 61. Shimada does not say that second insulating layer 8 prevents oxidation of source 3 and drain 4. See also Declaration of Larry D. McMillan (hereinafter "McMillan Declaration"), paragraph 6. In fact, it is not inherently clear that an oxide second insulating layer 8 as disclosed in Shimada would protect against oxidation. See McMillan Declaration, paragraph 7. Shimada does not mention or discuss using second insulating layer 8 as a hydrogen barrier layer or any other type of diffusion barrier layer. See McMillan Declaration, paragraph 8. In the Shimada reference, the purpose and the principle of operation of second insulating layer 8 is its role as an electrical insulator between floating electrode 9 on one side and source 3, drain 4, and tunnel-barrier insulator 5 on the other side. See McMillan Declaration, paragraph 9. The only discussion in Shimada concerning second insulating layer 8 relates to the permittivity of second insulating layer 8. See Shimada, column 4, line 63, to column 5, line 5. Shimada explains that it is preferable to choose a material of high permittivity such as SrTa_2O_6 (strontium tantalate) because ferroelectric layer 6 and second insulating layer 8 are equivalent to two capacitors in series. See Shimada, column 4, line 63, to column 5, line 5. Permittivity is directly related to the dielectric constant of a material by the equation:

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$$\epsilon = K\epsilon_0,$$

where ϵ is permittivity, K is a relative dielectric constant, and ϵ_0 is the permittivity of a vacuum. See McMillan Declaration, paragraph 10.

Applicants recognize that the rationale for combining references need not be identical with the rationale in the present application. See, e.g., MPEP 2144. Nevertheless, there is absolutely no suggestion or motivation either in the references or in the prior art in general to combine the teaching of high-permittivity second insulating layer 8 from Shimada with the teaching of hydrogen barrier layer 402 of Kanaya. See McMillan Declaration, paragraph 11. Similarly, there is absolutely no suggestion or motivation either in the references or in the prior art in general to combine the teaching of high-permittivity second insulating layer 8 from Shimada with the teaching of any insulating interlayers of Kanaya. See McMillan Declaration, paragraph 12.

In the Final Office Action dated June 16, 2003, at page 6 regarding claim 28, the Examiner wrote Kanaya discloses in FIG. 32 a hydrogen barrier layer 402 comprising an amorphous material. At page 11, paragraph 0187, Kanaya teaches that an Al₂O₃ film and an Al_xO_y film are amorphous when formed at a temperature of 400°C to 700°C. Kanaya does not teach "an amorphous hydrogen barrier layer material selected from the group consisting of strontium tantalate, bismuth tantalate, and tantalum oxide." Shimada does not teach any amorphous material. Therefore, neither Kanaya nor the combination of Kanaya with Shimada teaches an important limitation of currently amended claim 1; namely, "an amorphous hydrogen barrier layer material selected from the group consisting of strontium tantalate, bismuth tantalate, and tantalum oxide."

Currently amended independent claim 28 adds titanium oxide, zirconium oxide, and aluminum oxide to the group of amorphous hydrogen barrier layer materials, and it includes the new limitation that at least a portion of the amorphous hydrogen barrier layer material directly contacts the thin film of metal oxide material. Kanaya teaches an amorphous hydrogen barrier layer 402 between silicon oxide insulating interlayers 306a and 306b. See Kanaya, FIGS. 31A, 31B, 32; and page 11, paragraphs 0182 and 0187. Kanaya further teaches that insulating interlayer 306a comprising silicon oxide, nitrogen-containing

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silicon oxide, or $\text{Al}_x\text{Si}_y\text{O}_z$ functions to protect ferroelectric film 304 against reduction by metal elements of hydrogen barrier film 402. See Kanaya, page 11, paragraphs 0182, 0186, and 0187. Thus, Kanaya teaches a hydrogen barrier film 402 that is never in direct contact with ferroelectric film 304. Therefore, neither Kanaya nor the combination of Kanaya with Shimada teaches an important limitation of currently amended claim 28.

In summary, the combination of Kanaya and Shimada does not teach or suggest all of the claim limitations of amended independent claims 1 and 28. Since claims 2 – 8, 10 – 27, and claims 29 – 37 depend from claims 1 and 28, respectively, it is believed that these dependent claims are also not obvious.

Claims 5 – 8, 13, 17, 18, 23 – 27, 31, 35, and 37 were rejected under 35 USC 103(a) as being unpatentable over Kanaya, U.S. Patent Application Publication No. U.S. 2002/0038402 A1, in view of Shimada et al., U.S. Patent No. 6,351,004 B1, and further in view of Amanuma, U.S. Patent No. 6,188,098 B1.

Amanuma teaches aspects of integrated circuits that are included in some of the dependent claims; however, Amanuma does not teach the new limitations of independent claims 1 and 28 discussed above. As argued above, it is believed that amended independent claims 1 and 28 are not obvious; therefore, claims 5 – 8, 13, 17, 18, and 23 – 27 depending from amended independent claim 1, and claims 31, 35, and 37 depending from amended independent claim 28 are also not obvious.

Claim 45 was rejected under 35 USC 103(a) as being unpatentable over Amanuma as applied to claims 38 – 44 and 46 above, and further in view of Shimada.

Claim 45 has been canceled.

New, independent claim 69 includes the important limitations of: a metal oxide thin film; and a hydrogen barrier layer comprising an amorphous hydrogen barrier layer material selected from the group consisting of strontium tantalate, bismuth tantalate, tantalum oxide, titanium oxide, zirconium oxide, and aluminum oxide wherein no silicon-containing material is located between said amorphous hydrogen barrier layer material and said thin film of metal oxide material.

As discussed above, Kanaya discloses an amorphous hydrogen barrier film 402

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interposed between insulating interlayers comprising silicon oxide, nitrogen-containing silicon oxide, or $\text{Al}_x\text{Si}_y\text{O}_z$. None of the references taken alone or together teach the limitations of "no silicon-containing material" located between amorphous hydrogen barrier layer material and a thin film of metal oxide, as claimed in new claim 69. Since claims 70 – 83 depend from claim 69, it is believed that these dependent claims are allowable with claim 69.

New, independent claim 84 includes the important limitations of: a thin film of metal oxide material; and a hydrogen barrier layer comprising strontium tantalate formed from a liquid metal organic precursor in a process using MOCVD conducted at a temperature in a range of from 300°C to 650°C. Dependent claim 85 includes the additional limitation of a temperature in a range of from 400° to 500°C. None of the references taken alone or together teach all these limitations.

For the above reasons, pending claims 1 – 8, 10 – 18, 20 – 37, and 69 – 85 are believed to be patentable and their consideration and allowance are respectfully requested.

Fees for a two-month extension, Request for Continuing Examination, and additional claims are submitted herewith. If any additional fees are due, the Commissioner is authorized to charge them to Deposit Account No. 50-1848.

Respectfully submitted,
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